Electronic Version
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Claims

[c1] 1.A variable gain amplifier, comprising:
an amplifying stage for generating an output voltage according to an input voltage; and
a variable gain stage for adjusting a voltage gain of the amplifying stage according to at least a controlling voltage;
wherein the voltage gain is a simple exponential function, and the value of the simple exponential function is determined by the controlling voltage.

[c2] 2.The variable gain amplifier of claim 1, wherein the simple exponential function comprises a function which raises a base to the power of an argument, without an addition operation or a subtraction operation with a constant being performed on the function.

[c3] 3.The variable gain amplifier of claim 1, wherein the at least one controlling voltage comprises a first controlling voltage and a second controlling voltage, and the value of the simple exponential function is determined by the difference between the first and the second controlling voltages.

[c4] 4.The variable gain amplifier of claim 3, wherein the variable gain stage is a transconductance amplifier for generating a gain current according to the difference between the first and the second controlling voltages.

[c5] 5.The variable gain amplifier of claim 4, wherein the variable gain stage comprises:
a first transistor coupled to the first controlling voltage;
a second transistor coupled to the second controlling voltage;
a first current source coupled to the emitter of the first and the second transistors for providing a first current; and
a second current source for generating the gain current, wherein the value of the gain current is determined by the first current and the difference between the first and the second controlling voltages.

[c6] 6.The variable gain amplifier of claim 5, wherein the variable gain stage further comprises:
a first resistor coupled between the collector of the first transistor and the second current source; and
a second resistor coupled between the collector of the second transistor and the second current source.

[c7] 7.The variable gain amplifier of claim 5, wherein the amplifying stage comprises:

an input unit coupled to the input voltage for generating an input current according to the input voltage;
a current transforming unit for generating a second current according to the gain current; and
a transresistance amplifying unit for generating the output voltage, wherein the value of the output voltage is determined by the input current and the second current.

[c8] 8.The variable gain amplifier of claim 7, wherein the input unit comprises an input transistor coupled to the input voltage for generating the input current according to the input voltage.

[c9] 9.The variable gain amplifier of claim 7, wherein the current transforming unit comprises:
a third transistor, the collector of the third transistor being coupled to the base of the third transistor;
a fourth transistor;
a third current source coupled to the emitter of the third and the fourth transistors for providing a third current; and
a fourth current source for generating the second current;
whereby the ratio between the third current and the first current is substantially equivalent to the ratio between the second current and the gain current.

[c10] 10.The variable gain amplifier of claim 9, wherein the current transforming unit further comprises:
a third resistor coupled between the collector of the third transistor and the fourth current source; and
a fourth resistor coupled between the collector of the fourth transistor and the fourth current source.

[c11] 11.The variable gain amplifier of claim 9, wherein the transresistance amplifying unit comprises:
a fifth transistor, the base and the collector of the fifth transistor being coupled to the base of the fourth transistor;
a sixth transistor, the base of the sixth transistor being coupled to the base of the third transistor;
a seventh transistor, the base and the collector of the seventh transistor being coupled to the emitter of the fifth and the sixth transistors;
a fifth current source coupled to the input unit and the collector of the fifth transistor for providing a fifth current; and
an output resistor coupled to the collector of the sixth transistor for generating the output voltage.

[c12] 12.The variable gain amplifier of claim 3, wherein the voltage gain can be expressed as $C1 \times \exp(C2(V1-V2))$, wherein both C1 and C2 are constant values, V1 is the first controlling voltage, and V2 is the second controlling

voltage.

[c13] 13.The variable gain amplifier of claim 1, wherein the variable gain amplifier is the half-circuit of a differential amplifier.